U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

SSL: Early Lessons Learned on the Way to Market



Lightfair 2014

June 3, 2014

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CFL lessons applied to early LED market

- Coordination and collaboration is key
- Establish standards and product testing
- Introduce new lighting technology first in applications where benefits are clearly established
- Respond to the market and resolve problems/issues quickly

Many efforts started ~2007…  ***to 2013…***

How did we identify the SSL lessons?

- CALiPER testing
- LED Lighting Facts
- GATEWAY demonstrations
- Municipal Consortium
- DOE multiyear R&D planning, market studies, roadmaps
- DOE annual workshops and major industry events
- Extensive interaction with:
  - Manufacturers
  - Utilities & energy efficiency programs
  - Lighting designers & specifiers
  - Retailers
  - Building owners
  - Municipalities

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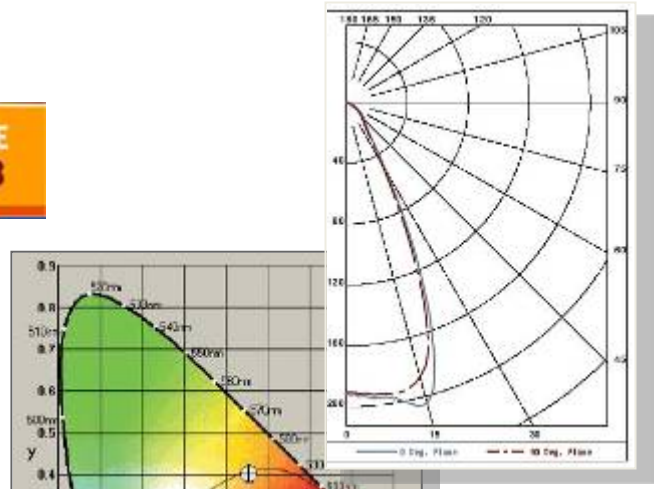
Lesson 1: Testing Costs

Rigorous testing requirements adopted in the early days of SSL industry development were necessary to counter exaggerated claims of performance by some manufacturers, but they eventually led to unreasonably high testing costs

YOU MAY NEVER CHANGE ANOTHER LIGHT BULB

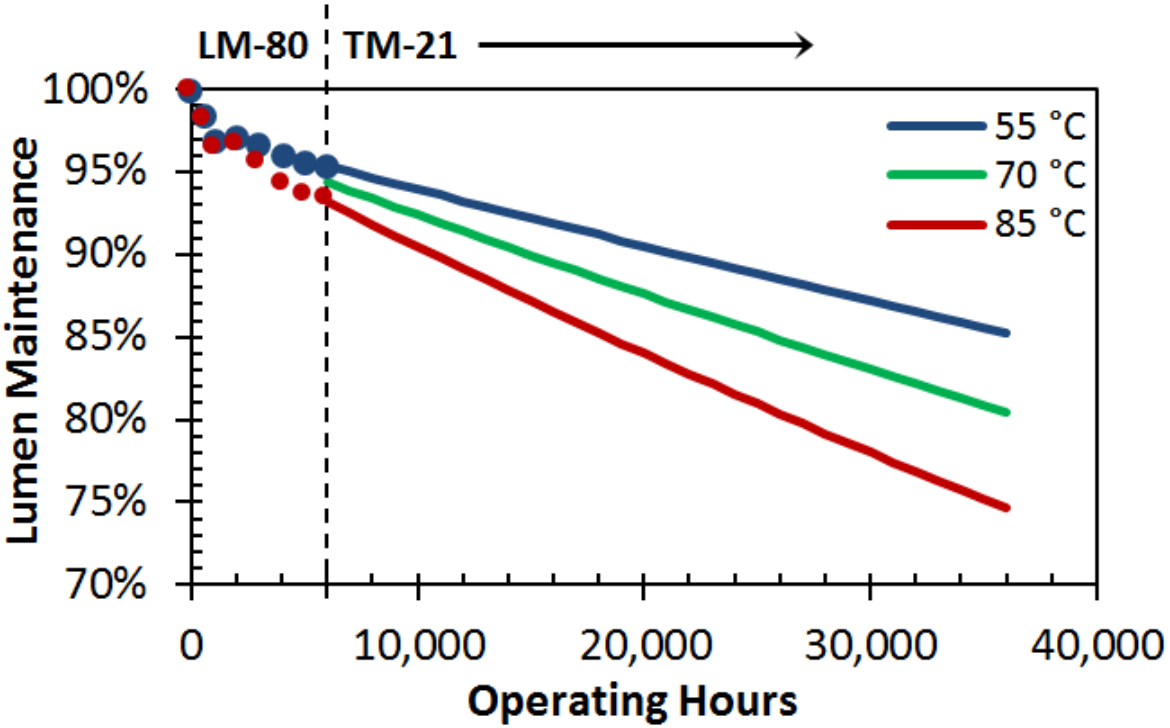
True Color 2700K

Lasts 100k hours!



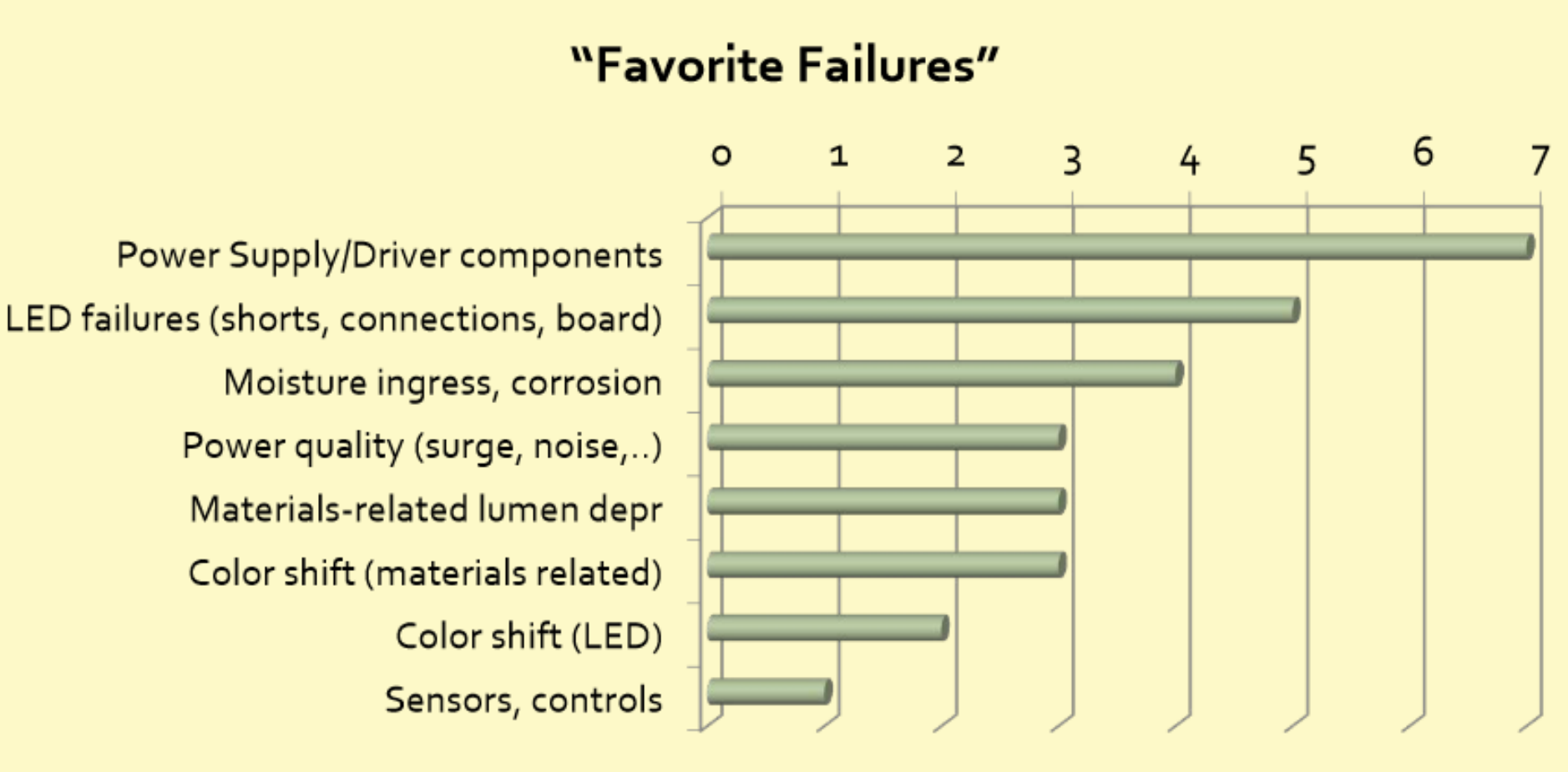
Lesson 2: Lifetime

Despite the promise of long life, there is no standard way to rate the lifetime and reliability of LED products



LED package lumen maintenance is PART of the story but not the WHOLE story

What actually fails and why?



LED Systems Reliability Consortium, 2013

Lesson 3: Product families

Specifiers prefer complete families of products, but the rapid evolution of LED technology presents a challenge to manufacturers in creating and maintaining complete product lines

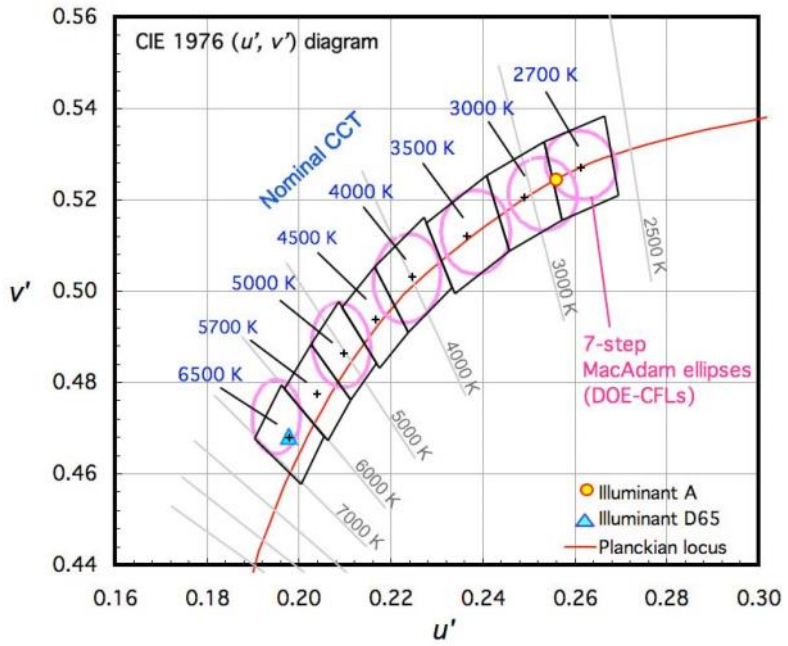
	16151	16135	16134
Image:			
Product Number:	16151	16135	16134
Name:	50PAR30HALIRSSP10TL 120 10/CS 1/SKU	39PAR30HALWFL50DL 120V 10/CS I/SKU	39PAR30HALNFL25DL 120V 10/CS 1/SKU
Select For New Comparison:	☑	☑	☑
Details			
Abbrev. With Packaging Info.	50PAR30HALIRSSP10TL 120 10/CS 1/SKU	39PAR30HALWFL50DL 120V 10/CS I/SKU	39PAR30HALNFL25DL 120V 10/CS 1/SKU
Approx. Lumens	950	520	520
Average Rated Life (hr)	4500	3000	3000
Base	E26 Medium	E26 Medium	E26 Medium
Beam Angle (deg)	10	50	25
Beam Type	SP	WFL	FL
Bulb	PAR30	PAR30	PAR30
Centerbeam Candlepower (cp)	10600	600	1600
Class	C (gas)	C (gas)	C (gas)
Color Rendering Index (CRI)	99	100	100
Color Temperature/CCT (K)	2800	2800	2800

Source: Osram Sylvania

Lesson 4: Color quality

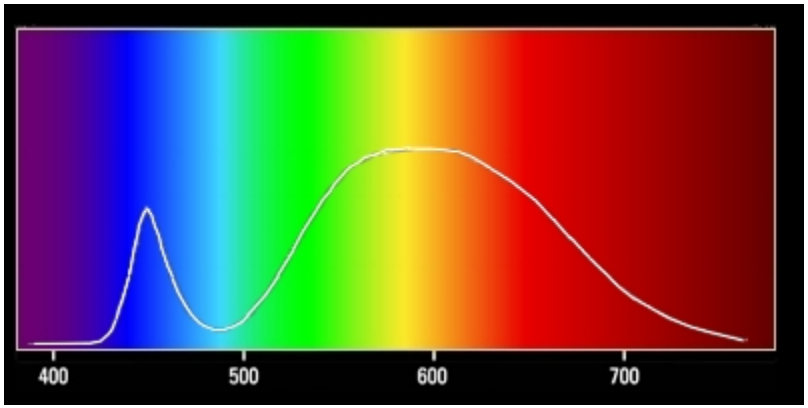
The range of color quality available with LED-based products and the limitations of existing color metrics may confuse users

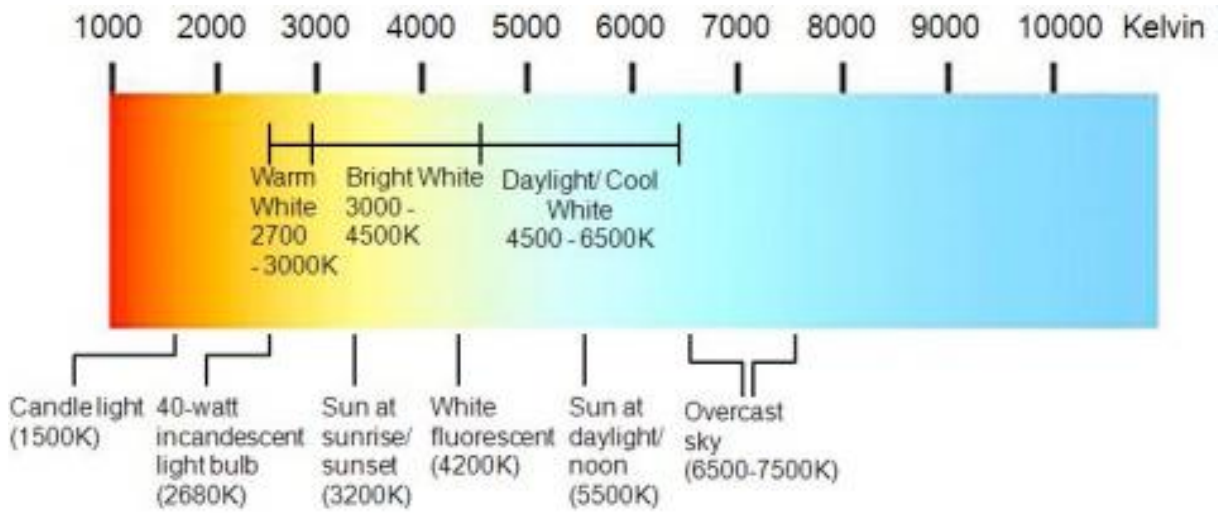
TMI?



CCT, Duv, CRI, SPD, gamut area, CQS, Macadam ellipses

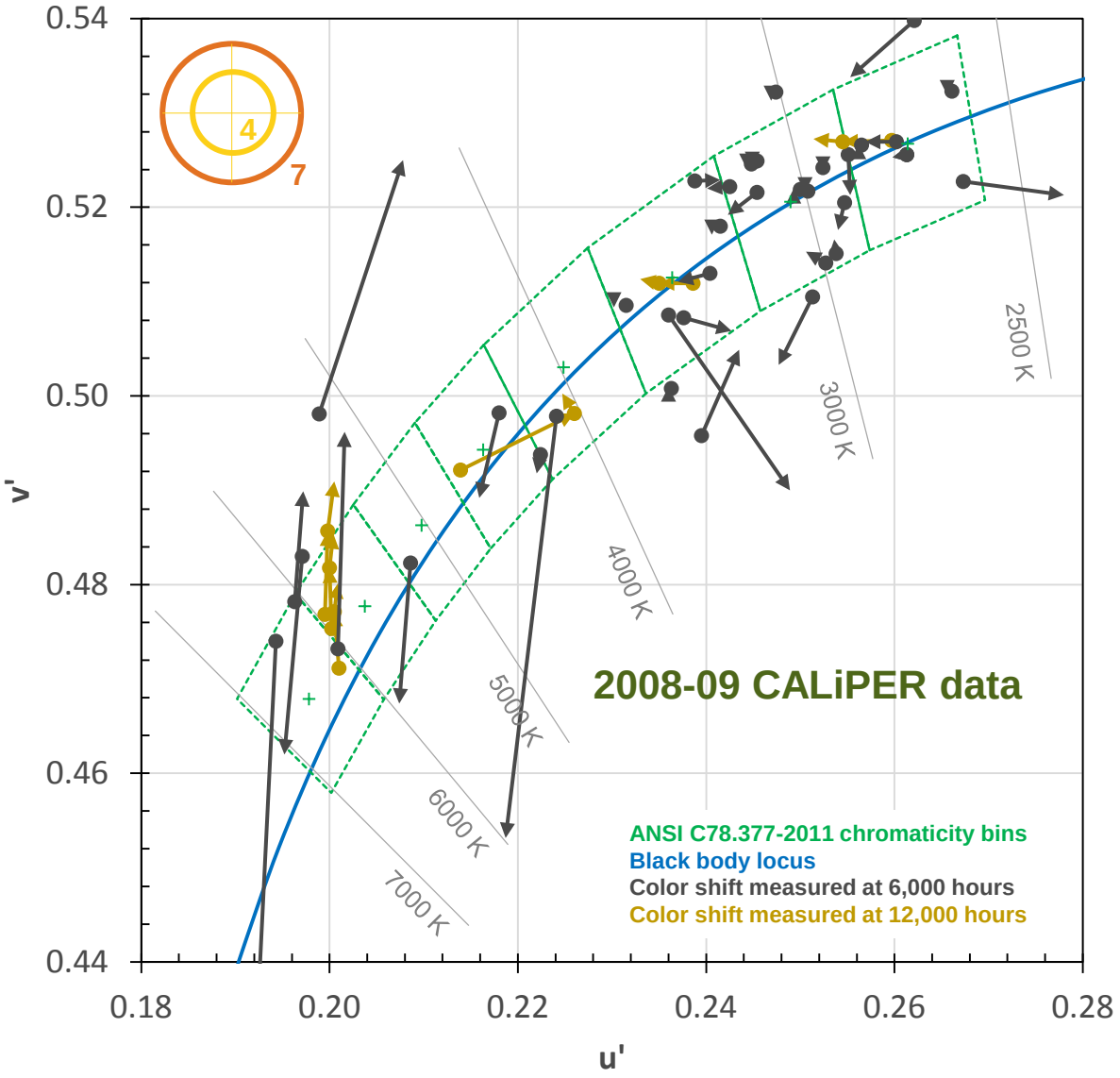
"soft white", "bright white", "daylight" -- ??



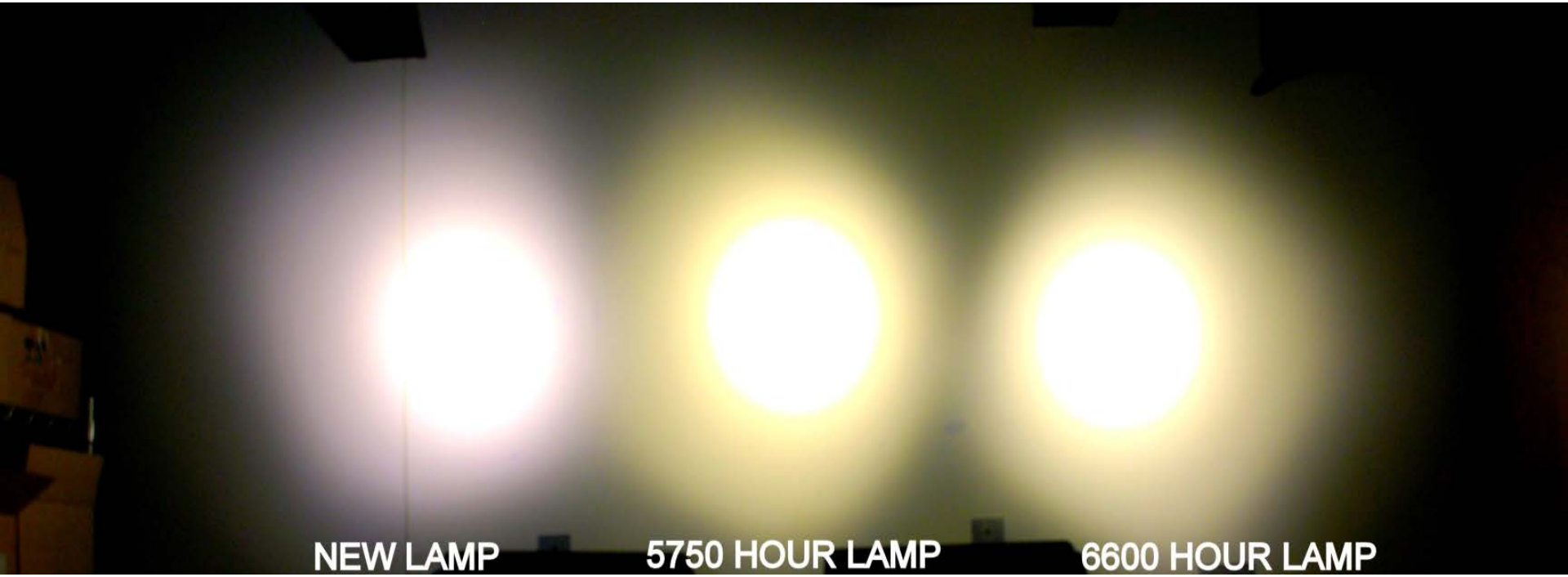


Lesson 5: Color stability

The color delivered by some LEDs shifts over time, enough to negatively impact adoption in some applications



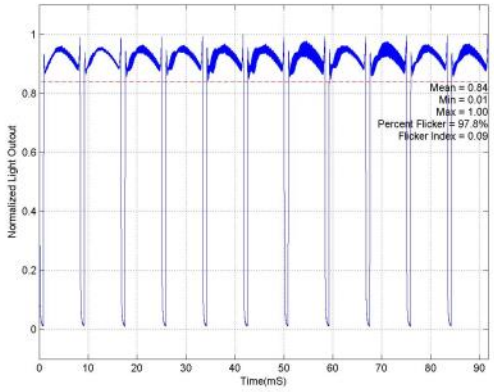
Can be noticeable in some applications



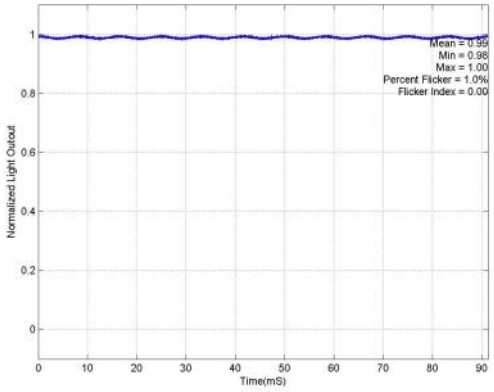
Source: Smithsonian American Art Museum

Lesson 6: Flicker

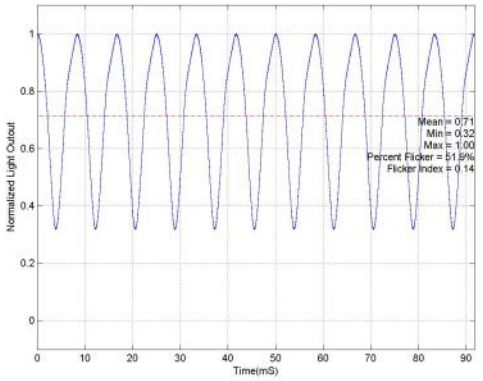
Some LEDs flicker noticeably, which may negatively impact adoption in some applications



LED Product A



LED Product B



LED Product C

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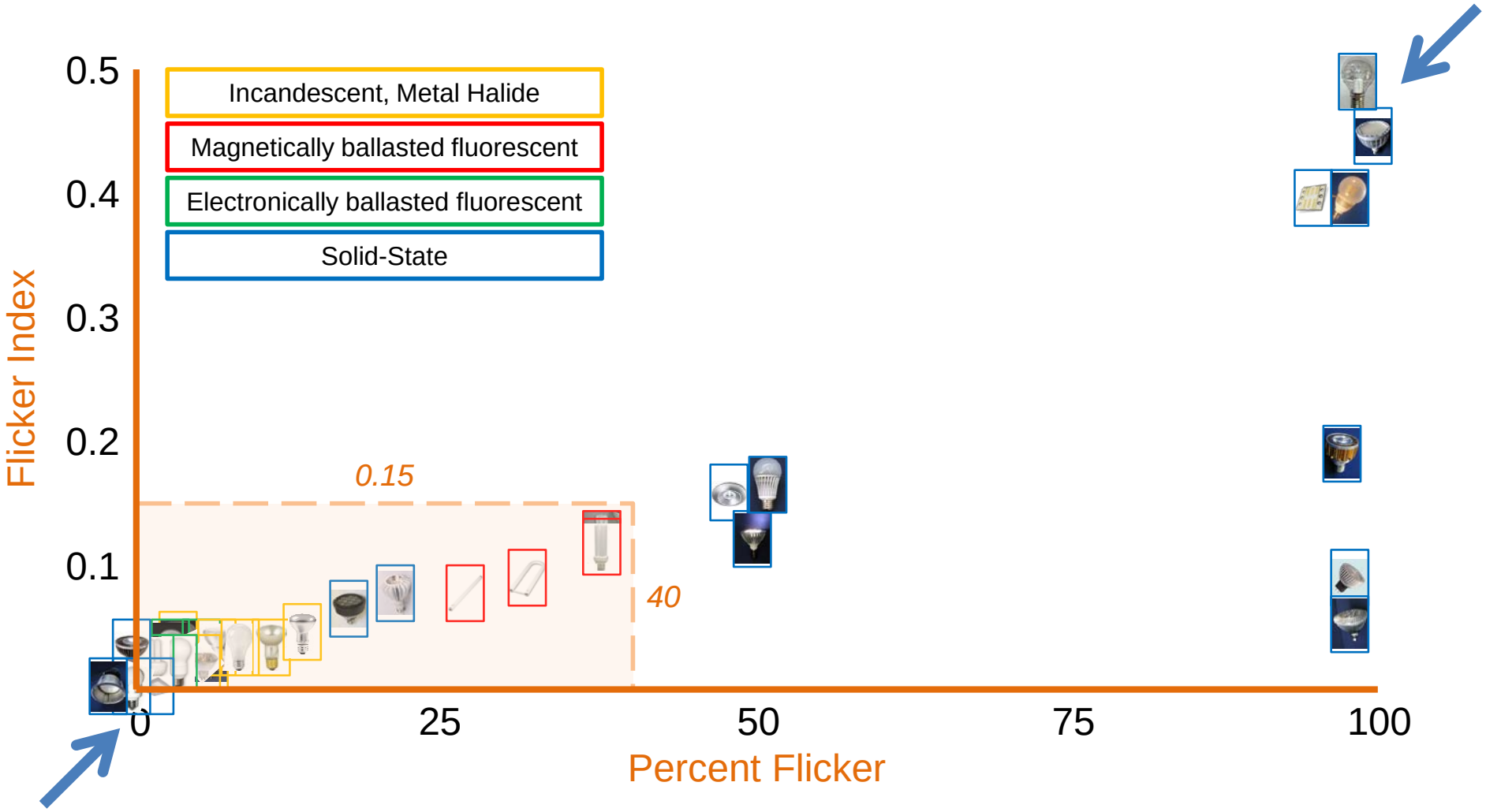
LEDs can flicker more than other sources



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Lesson 7: Glare

LEDs can cause glare, which may negatively impact adoption in some applications

Lesson 8: Dimming

Achieving high-quality dimming performance with LED lamps is difficult, but improving

Depending on:

1) characteristics of the LED sources (drivers)
2) characteristics of the dimmer
3) number and type of light sources on the circuit

You might encounter:

- Limited dimming range
- Unpredictable dimming curve
- Dead travel
- Pop-on
- Drop-out
- Flashing, ghosting
- Premature failure
- Audible noise
- Inoperability

Lesson 9: Interoperability

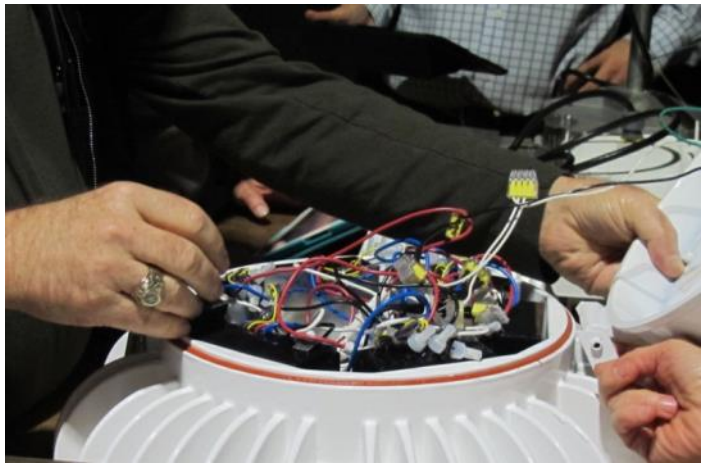
Greater interoperability of lighting control components and more sensible specifications of lighting control systems are required to maximize the energy savings delivered by LED-based sources

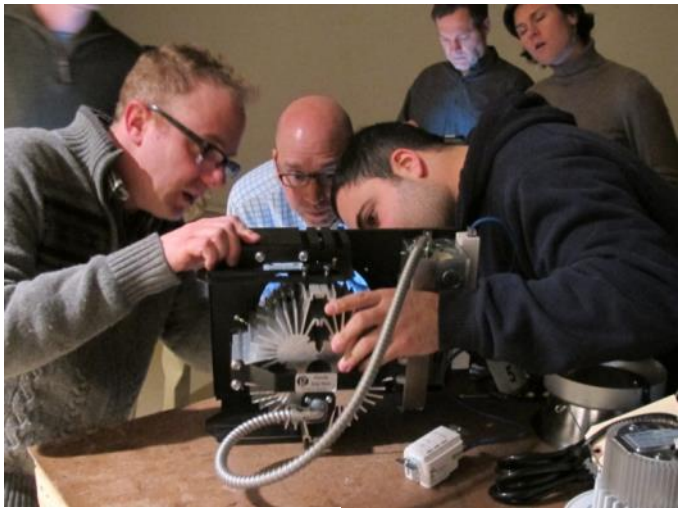
Lighting Control on Wi-Fi network

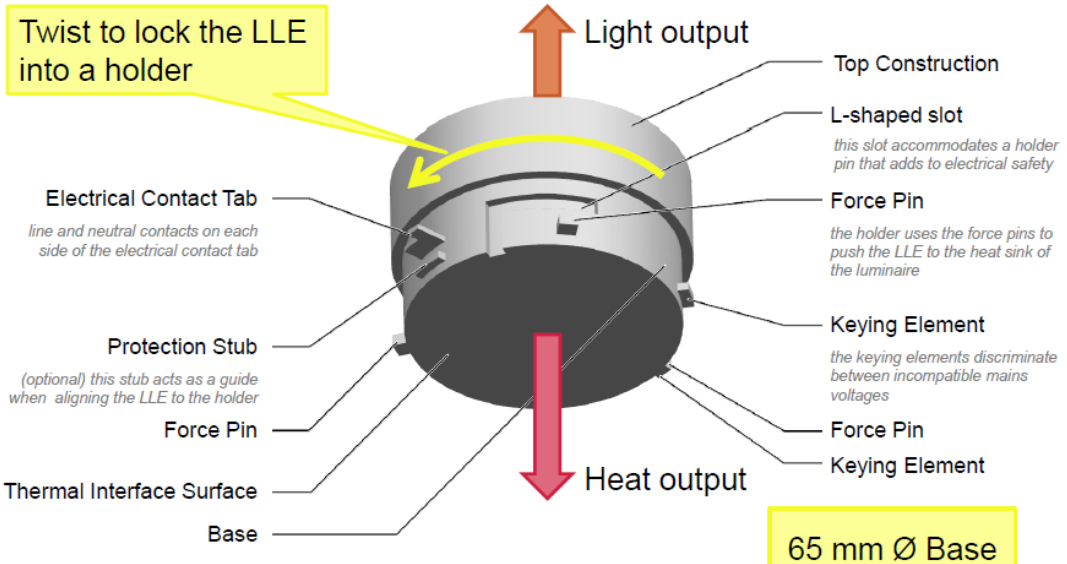
Example: ZigBee Light Link to Ethernet Gateway

Lesson 10: Serviceability

Lack of LED product serviceability and interchangeability has created market adoption barriers in certain sectors





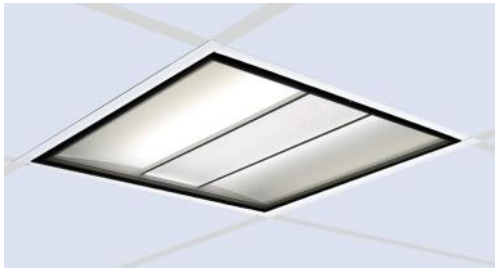


Example: Zhaga Book 2 mechanical interface

Lesson 11: Existing infrastructure

Existing lighting infrastructure limits the full potential of SSL; more effort is needed to open the doors to new lighting systems and form factors

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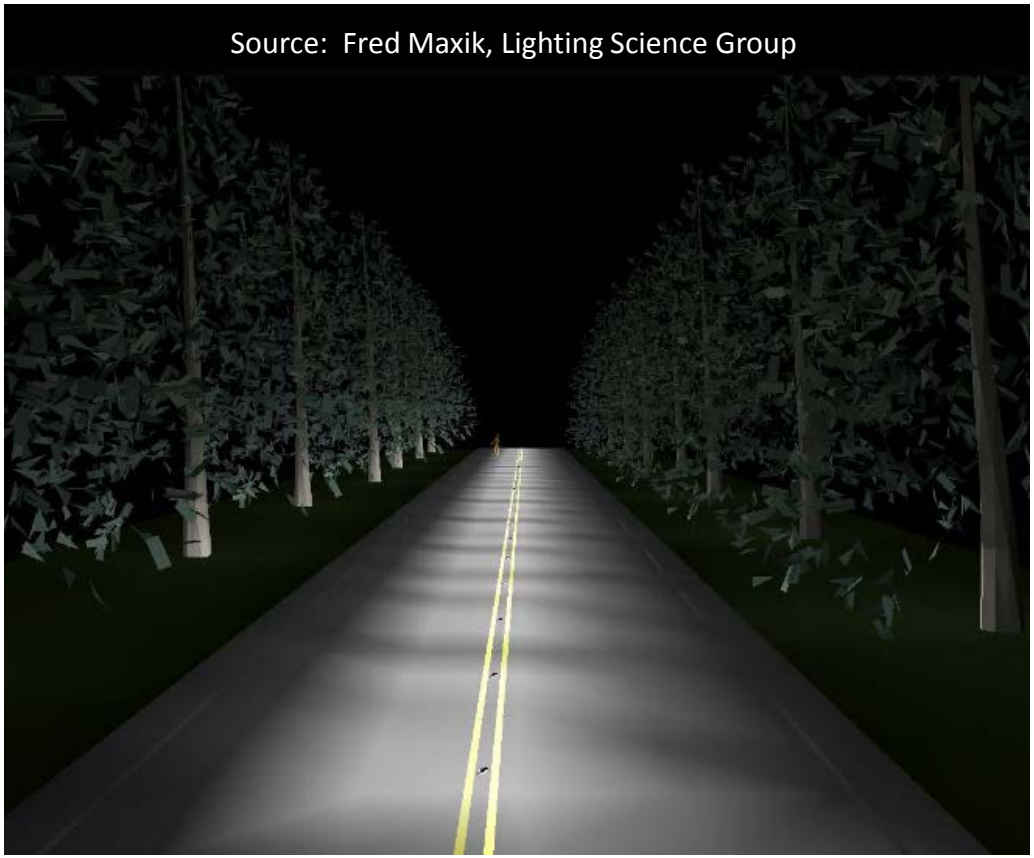
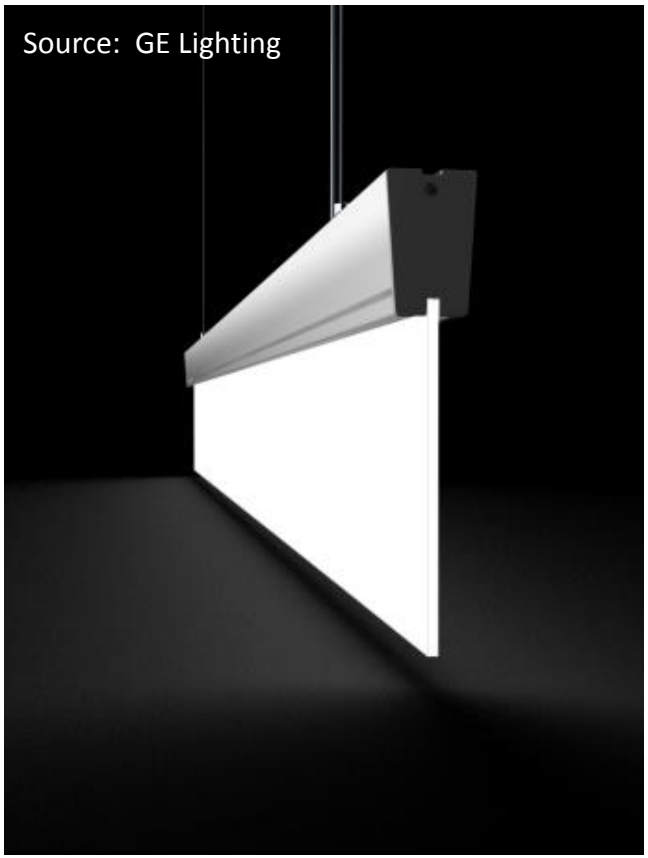
What else can it do?





Lesson 12: Qualification programs

Programs that provide ways to identify quality LED products have helped support market adoption

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LED Lighting Facts

- Manufacturers voluntarily list products in program, posting LM-79 information
- Intended to promote accurate manufacturer performance claims
- No minimum performance requirements
- Used by utilities, lighting professionals, and retailers to qualify products
- Some national retailers require LED Lighting Facts listing

www.lightingfacts.com

Thank You

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Get the SSL Lessons Learned report at:
www.ssl.energy.gov